TRANSLATING IDEAS INTO MARKETABLE PRODUCTS: EDUCATING AND SHAPING THE FUTURE PRODUCT DESIGNERS

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ABSTRACT
Various aspects of the interdisciplinary design course, the BSc Product Design Technology (PDT) course, including the influences of globalisation, had been explored and reported in IEPDE04 and EPDE06. The role and importance of the design discipline in sustaining UK economic growth has prompted a vertical integration between schools and universities in the provision of design education. In spite of this vertical integration, it is still a challenging task educating and shaping future product designers to enable them to transform their innovative ideas to products for the global market through the iterative design process. Experience shows that a significant proportion of students in product design courses find it difficult to grasp and appreciate the differences between various stages of the design process, particularly the embodiment, detailed design stages and communication of the resultant design through technical drawings. PDT integrates applied sciences and applied arts, interweaving them with participative design modules and supportive taught modules. Pedagogical research specific to PDT in this university is being carried out and the resultant "learners' engagement model", which can form the basis for discipline and strategic development, is used to address some observed weakness in students' performance in design.

Keywords: Engineering design, industrial design, learning model, pedagogical research

1 INTRODUCTION

Various aspects of the interdisciplinary design course, the BSc Product Design Technology (PDT), including the influences of globalisation, had been explored and reported in IEPDE04 and EPDE06 [1, 2]. Recognising the role and importance of the design discipline in sustaining UK economic growth and taking advantage of globalisation as presented in the Cox Report [3], there is evidence suggesting the existence of a vertical integration between schools and universities in the provision of design education. Product design and design technology are two popular subjects taken by students in schools. Hence there is a natural progression for aspired product designers from secondary, pre-university to university education in this discipline.

Globally, pedagogical issues relating to the design and delivery of design courses in the face of technological progress and globalisation have prompted a number of responses from academics in design education in both the industrial design and engineering design disciplines. Wak's [4] approach to design education is a philosophical one. Utilitarian

and ideological treatments of engineering design and industrial design education pedagogical issues have also been explored [5], [6]. Balaram [7] described the development of design education pedagogical development in India in which unification of past traditions, contemporary styles, science and technology has resulted in a project-based approach to design education. The problem-solving approach has also been proposed [8] as an alternative for design in technology education. Hence, this continuous process of evolution ensures design education matches the pace of economical and technological progress.

This paper reviews the continuous development of the interdisciplinary PDT course, some pedagogical issues related to PDT, briefly discusses pedagogical research in Northumbria University associated with product design and the resultant strategic direction in shaping and educating future product designers.

2 PEDAGOGICAL ISSUES RELATED TO PDT

The main characteristic of this course is interdisciplinary integration of industrial design and engineering design, interweaving applied arts and applied sciences (or technology) within a single course. Correspondingly, the main theme of the course consists of a series of industrial design and engineering design modules throughout the three years, the most prominent of which is the final year major project module, interweaved with supportive modules such as technology, ergonomics, ethics and sustainability. The curriculum of the course has gone through a number of refinements and enhancements in academic contents, industrial collaboration/input and development of professionalism amongst the students.

Interweaving and integrating applied arts and applied sciences in participative design modules and supportive taught modules is a both a demanding endeavour and an interesting experience: design modules require a certain approach in learning and teaching which consists of substantial continuous feedback, lecturers-students interactions and are assessed through students' portfolio work; taught modules rely on conventional lectures, seminars, laboratory work in delivery and are assessed through a combination of written examinations, tests and assignments. Hence the integration involves interweaving two different teaching and learning approaches within two different disciplines.

Design (engineering and industrial) is inherently a complex subject and it is generally agreed that mastery of the subject matter and attainment of design competency involve more than the usual lecturing, seminar and laboratory teaching and learning methods. Pedagogical researchers in design have suggested two approaches in assisting the learners to grasp and master the complexity of design skills and competency: experiential learning [9, 10] and problem-based learning [8, 11, and 12]. These two approaches, in broad terms, agree with intuition of educators in both engineering design and industrial design that students need to be guided, supervised and allowed to learn from experience and mistakes through a series of design projects. In this respect, the delivery mode of industrial and design engineering design modules of the course is inline with these two approaches.

Regardless of participative design modules or supportive taught modules, the main objectives of teaching and learning are to encourage deep learning, engagement and

building of designer identity and professionalism. The implicit emphasis of Northumbria University's product design education is on the development of students' design capability through design processes in which iteratively and incrementally design ideas satisfying a set of market-informed needs are transformed into final designs, the communication of which involves both technical information (in the form of detailed technical drawings), business-oriented information (costing, market survey etc) and aesthetic information. Pedagogical research is an important aspect of research carried out in the university as a means to achieve excellence in teaching and learning. A current collaborative pedagogical research between the School of Computing, Engineering and Information Sciences and the HEFCE funded Centre of Excellence for Teaching and Learning[1] investigates what constitutes being an engineer or a product designer. Preliminary result from this research can be summarised as a model of students' learning through various levels of engagement as shown in Figure 1.

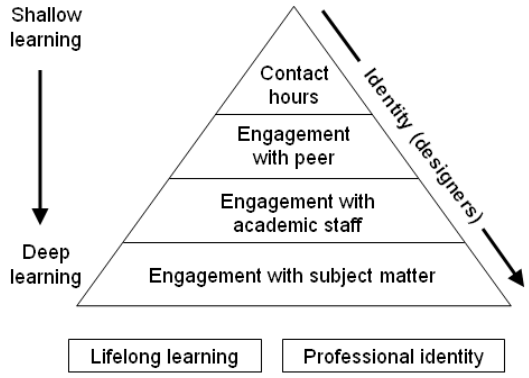

Figure 1 A learning model of different levels of engagement

It can be seen from Figure 1 that students' engagement can be viewed from a hierarchical perspective starting from contact hours in the timetabled sessions with gradual deepening of engagement with peers, academic staff (directed learning) and finally a pro-active engagement with the subject matter in which the learners actively seek knowledge, know-how and skills. The model's hierarchical structure maps reasonably well with the notion of shallow and deep learning approaches to learning [13]. For product designers the learning process also leads to building of identity as designers towards professional recognition. This model is in its early conceptual stage and still requires refinement, further development and validation. It is anticipated that the validated model will form a basis for subject and strategic development for PDT.

3 BUILDING IDENTITY AND ENGAGING THE STUDENTS

In spite of the existence of a vertical integration in design education, experience gained from PDT revealed that it is still a challenging task educating and shaping the future product designers to enable them to transform their innovative ideas to products for the

[1] CETL AfL funded research "Becoming and Being an Engineer: Can it be Taught?" in collaboration with the School of Computing, Engineering and Information Sciences.

global market through the iterative design process. Various issues, such as limitations of students; mathematical skills, resistance to the discipline of sciences, a lack of vision in design, a lack of professionalism, etc., had been raised in IEPDE04 and EPDE06 and means to deal with these issues had been suggested and implemented [1, 2] with varying degrees of success. Evidence from students' and staff feedback suggested significant improvements tend to occur in taught modules whereas relatively little improvements are observed from participative engineering design and industrial design modules. Experiential learning/problem-based learning requires the learners to adopt a deep learning approach, which corresponds to engagement with the subject matter of design, and progress through a series of iterative cycles of experience, reflective observation, abstract conceptualisation and active experimentation [14]. In the case of design modules, commitment from students and engagement to the subject matter of design also helps to build the students' identity as product designers and hence gradually progress towards professional identity.

3.1 Observed Weakness in Students' Performance in Design Modules

Experience shows that a significant proportion of students in PDT find it difficult to grasp and appreciate the differences between various stages of the design process. Often, students failed to perform a thorough exploration of initial design ideas before launching into conceptual, embodiment and detailed designs. The interdisciplinary nature of product design demands designers to attend to both aesthetics and technical details and as a result it is a demanding task for the students to fulfil the requirements of two very different disciplines: industrial design and engineering design. There is a natural tendency for students who are relatively competent in industrial design but relatively weak in engineering knowledge to present impressive aesthetic sketches but inadequate technical and manufacturing details in their engineering drawings. With globalisation, the designing and manufacturing activities of a given product may be carried out in a collaborative, concurrent and distributive manner. Communication of design information between different agents within the distributive design, manufacturing and distribution environment is paramount in this setting. Hence the ability to generate adequate aesthetic and technical details from a set of innovative deign ideas through a design process and to communicate these details forms an important aspect of product design education.

3.2 Engagement in Subject Matter to Overcome Weaknesses and Build Identity

The observed weakness in students' performance in design modules is a result of a lack of engagement in the subject matter and an indication of a lack of students' identity and a manifestation of a lack of professionalism. To overcome this weakness, students need to be encouraged to adopt a deep learning approach to engage the subject matter and build professional identity as competent and creative product designers.

Peer support is an important form of motivation which can be exploited to foster subject matter engagement (e.g. "live product design and breathe product design"). Promotion of interactions with peers and clients through studio culture tends to encourage students to communicate as practitioner designers in-training and to benefit from peer-support and constructive criticism in their development of design skills. Immersion in such a professional environment is a way to develop deep learning and subject matter engagement. Studio culture is an integral part of design courses, vibrant and active studio activities help the students to build identity of product designers.

To enrich the students' learning experience in global communication an international collaborative research programme has been set up with two universities in the Netherlands and Scotland. This research is incorporated into two second-year design modules within the curriculum and allows PDT students from this university to communicate both as designers and clients with product students from the partner universities. Communication, including aesthetic, technical and implicit cultural information, will be an important element of this research.

The key to help students develop deep, subject matter engagement that leads naturally professionalism is a conducive and supportive environment. Within this supportive environment students can learn by immersion in design culture and derive satisfaction from the endeavour which encourages deeper learning. Students who are able to engage the subject matter performed exceptionally well in their final year design projects. Figure 2 shows two such examples of functional prototypes: a pole driver for rural farmers that requires application of substantial engineering ingenuity and a cutting aid for disabled children that incorporates industrial design and design for manufacturing consideration.

Figure 2: Two final year projects: pole driver and cutting aid for disabled children

4 CONCLUSION

Some excellent final year projects, covering both engineering design and industrial design aspects, have been developed by PDT graduates, one of which had recently won a prize in a UK national competition and another had attracted commercial interest and funding for further development aim at a niche sector. Hence interweaving experiential and conventional learning with two disciplines in a degree programme is a difficult but not impossible task. The learning model shown in Figure 1 establishes a strategy for which students can be guided to achieve deep learning and lifelong learning – achieving the aims of being professional product designers. Feedback provided by current students and graduates indicate that the learning model and the associated strategy is achievable and desirable. With the emphasis on design education [1] it is expected that PDT and similar courses will contribute significantly to UK economic growth and consequently one would expect to see sustainable recruitment in these courses.

REFERENCES

[1] Cox, G., Cox Review of Creativity in Business: Building on the UK's Strengths, HM Treasury, London, 2005, available at www.hm-treasury.gov.uk/cox.

[2] Connor, C. G., Fleming, W. J. and Tan, J. K., Creation of an interdisciplinary design curriculum at Northumbria University, *Proceedings of the 2nd International Engineering and Product Design Education Conference*, September 2 – 3/04, Delft, The Netherlands, pp. 35 – 42.

[3] Tan, J. K., Fleming, W. J., Connor, C. J. and Wilson, C., Development of an Interdisciplinary Design Curriculum: Preparing the Students for Final Year Major Design Projects, *Proceedings of the Engineering and Design Education Conference*, September 6 – 8 2006, Salzburg.

[4] Waks, L. J., Donald Schon's philosophy of design and design education, *International of Technology and Design Education*, Vol. 11, 2001, pp. 37 – 51.

[5] Ron H., The value of a utilitarian curriculum: The case of technological Education, *International Journal of Technology and Design Education*, Vol. 7, Numbers 1-2, 1997, pp. 111-119.

[6] Hsiao, H. and Cheng, Y., The impact of ideology on the interaction between tutors and students in the education of industrial design: A case study in Taiwan, *International Journal of Educational Development*, Vol. 26, Issue 1, 2006, pp. 6 – 23.

[7] Balaram, S., Design pedagogy in India: a perspective, *Design Issues*, Vol. 21 Issue 4, 2005, pp. 11 - 22.

[8] Hill, A.M., Problem solving in real-life contexts: An alternative for design in technology education, *International Journal of Technology and Design Education*, Vol 8, Number 3, 1998, pp. 89 – 92.

[9] Stumpf, S. C. and McDonnell, J. T., Talking about Team Framing: Using Argumentation to Analyse and Support Experiential Learning in Early Design Episodes, *Design Studies*, Vol. 23, Number 1, 2002, pp. 5 – 23.

[10] Cardozo, R. N., Durfee, W. K., Ardichvili, A., Adams, C., Erdman, A. G., Hoey, M., Iaizzo, P.A., Mallick, D. N., Bar-Cohen, A., Beachy, R. and Johnson, A., Experiential Education in New Product Design and Business Development*, Journal of Product Innovation and Management*, Vol. 19, 2002, Issue 1, p. 4.

[11] Grierson, H., Wodehouse, A., Ion, W. and Juster, N., Supporting Reflection and Problem-Based Learning Through the Use of LAULIMA, *Proceedings of Engineering and Product Design Education Conference*, 15 – 16 September 2005, Napier University, Edinburgh, UK.

[12] Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D. and Lefier, Engineering Design Thinking, Teaching and Learning, *Journal of Engineering Education*, 2005, pp. 103 – 120.

[13] Marin K. and Saljo, R., On Qualitative Differences in Learning. I – Outcomes and Process. *British Journal of Educational Psychology*, 1976, Vol. 46, pp. 4 – 11.

[14] Kold, D. A., Experiential Learning: Experience as the Source of Learning and Development, Englewood Cliffs, NJ, USA, Prentice Ha; 1984.

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